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DETAILED DESCRIPTION

[Detailed Description of the Invention]**[0001]**

[Field of the Invention] This invention relates to the luminescent material for organic electroluminescence (EL) elements and the high-intensity light emitting device which are used for a planar light source or a display.

[0002]

[Description of the Prior Art] Promising ** of the use as a cheap solid luminescence type large area full color display device is carried out, and, as for the EL element which uses an organic substance, many development is performed. Generally EL comprises a counterelectrode of the couple which sandwiched the luminous layer and this layer. When an electric field is impressed between two electrodes, an electron is poured in from the negative pole side and, as for luminescence, an electron hole is poured in from the anode side. When this electron recombines with an electron hole in a luminous layer and an energy level returns from a conducting zone to a valence band, it is a phenomenon which releases energy as a light.

[0003] The conventional organic EL device had high driver voltage compared with the inorganic

EL element, and light emitting luminance and its luminous efficiency were also low.

Characteristic degradation is also remarkable and it had not resulted in utilization. In recent years, the organic EL device which laminated the thin film containing an organic compound with the high fluorescence amount child efficiency which emits light by the low voltage not more than 10V is reported, and the interest is attracted (refer to it applied physics Letters, 51 volumes, 913 pages, and 1987). The metal chelate complex was used for the fluorescent substance layer, it used the amine compound for the hole injection layer, and this method has obtained high-intensity green emission.

With the direct current voltage of 6-7V, luminosity attains several 1000 cd/m^2 , the maximum luminous efficiency attains 1.5 lm/W, and it has the performance near a practical use field.

[0004]However, although luminescence intensity is improved by the improvement of composition as for the organic EL device by the present, it does not have still sufficient light emitting luminance. It has the big problem of being inferior to the stability at the time of repeated use. In order to raise the luminous efficiency of an organic EL device, the art which dopes and produces a guest substance to the host substance which is a luminescent material about a luminous layer is indicated. For example, a tris (8-hydroxyquinoline) aluminium complex in a luminous layer to a host substance. Although there was an organic EL device (refer to it Journal of Applied Physics, 65 volumes, 3610 pages, and 1989) which doped coumarin coloring matter or DCM coloring matter as a fluorescence guest substance, the luminous efficiency of these organic EL devices was not enough. The organic EL device which doped Quinacridone or a quinazoline compound as a fluorescence guest substance to the host substance is indicated in the tris (8-hydroxyquinoline) aluminium complex in the luminous layer (JP,05-70773,A). However, although the initial luminous efficiency of these organic EL devices was improving, degradation at the time of making light emit continuously was remarkable, and there was a practically big problem. Since pigment content children are condensing this firmly with that the art which dopes a little fluorescence guest substances is difficult for a luminous layer and indicated Quinacridone, or a quinazoline compound, it is difficult to dope uniformly into a luminous layer. Since it is such, the actual condition is that development of the organic EL device where doping uniformly into a luminous layer had an easy fluorescence guest material and higher luminous efficiency and which was excellent in the stability in the time of repeated use is desired.

[0005]

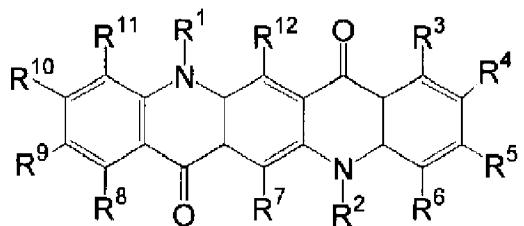
[Problem(s) to be Solved by the Invention]The purpose of this invention has high luminous efficiency, and is in offer of the organic EL device which was excellent in the stability in the time of repeated use. as a result of this invention persons' inquiring wholeheartedly, the luminous efficiency of the organic EL device which boiled further at least a kind of organic EL device material of the compound shown by a general formula [1], and uses it at least was high, and it found out that the stability in the time of repeated use was also excellent, and resulted in this invention.

[0006]

[Means for Solving the Problem] That is, this invention is an organic electroluminescence element material which consists of a compound shown with a following general formula [1].

[0007]General formula [1]

[Formula 4]



At least one in $R^1 - R^2$ expresses among [type the aromatic ring group which is not replaced [the alkyl group which is not replaced / substitution or /, substitution, or]. $R^3 - R^{12}$ The alkyl group which is not replaced [a hydrogen atom, a halogen atom, substitution, or], The thioalkoxy group which is not replaced [the alkoxy group which is not replaced / substitution or /, substitution or], A cyano group, an amino group, and mono- **** A JI substituted amino group, a hydroxyl group, a sulphydryl group, The arylthio group which is not replaced [the aryloxy group which is not replaced / substitution or /, substitution or], The aromatic ring group which is not replaced [the alkyl ring group which is not replaced / substitution or / substitution or], The heterocycle group which is not replaced [substitution or] is expressed, respectively (it may join together by the adjoining substituents and the heterocycle which is not replaced [the heterocyclic aromatic ring which is not replaced / the aromatic ring which is not replaced / the alkyl ring which is not replaced / substitution or /, substitution, or /, substitution, or /, substitution, or] may be formed.).]

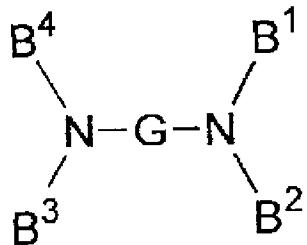
[0008]In an organic electroluminescence element in which an organic compound film of two or more layers which contains a luminous layer or a luminous layer in inter-electrode [of a couple] was formed, this invention is an organic electroluminescence element whose at least one layer is a layer containing the above-mentioned organic electroluminescence element material.

[0009]In an organic electroluminescence element in which an organic compound film of two or more layers in which this invention contains a luminous layer or a luminous layer in inter-electrode [of a couple] was formed, A luminous layer is an organic electroluminescence element which is a layer containing a metal complex compound and the above-mentioned organic electroluminescence element material.

[0010]In an organic electroluminescence element in which an organic compound film of two or more layers in which this invention contains a luminous layer or a luminous layer in inter-electrode [of a couple] was formed, A luminous layer is an organic electroluminescence element which is a layer containing the third class of aromatic amine compound, and the above-mentioned organic electroluminescence element material.

[0011]This invention is an organic electroluminescence element whose the third class of aromatic amine derivative is a compound shown with a following general formula [2]. General formula [2]

[Formula 5]

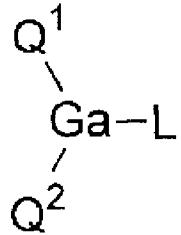


$B^1 - B^4$ express independently an aryl group with 6-20 carbon atoms which are not replaced [substitution or] among [type, respectively. G expresses an allylene group which is not replaced [substitution or].]

[0012]In an organic electroluminescence element in which an organic compound film of two or more layers in which this invention contains a luminous layer or a luminous layer in inter-electrode [of a couple] was formed, An electronic injection layer is an organic electroluminescence element which is a layer containing a metal complex compound and the above-mentioned organic electroluminescence element material.

[0013]This invention is the above-mentioned organic electroluminescence element whose metal complex compound is a compound shown with a following general formula [3]. General formula [3]

[Formula 6]



Q^1 and Q^2 among [type, Independently, express the hydroxy benzoquinoline derivative which is not replaced [the hydroxyquinoline derivative which is not replaced / substitution or /, substitution, or], respectively, and L, The cycloalkyl group which is not replaced [the alkyl group which is not replaced / a halogen atom, substitution, or /, substitution or], the aryl group which may also contain the nitrogen atom which is not replaced [substitution or], and -OR (R - a hydrogen atom.) The cycloalkyl group which is not replaced [the alkyl group which is not replaced / substitution or /, substitution or], It is an aryl group which may also contain the nitrogen atom which is not replaced [substitution or]. The ligand expressed with $-O\text{-}Ga\text{-}Q^3$ (Q^4) (Q^3 and Q^4 express the same meaning as Q^1 and Q^2 .) is expressed.]

[Embodiment of the Invention]

[0014] As an alkyl group which is not replaced [the substitution of R^1 of the compound shown

by the general formula [1] of this invention - R^2 , or], A methyl group, an ethyl group, a propyl group, a butyl group, a sec-butyl group, a tert-butyl group, A pentyl group, a hexyl group, a heptyl group, an octyl group, a stearyl group, There are a trichloromethyl group, a trifluoromethyl group, a cyclopropyl group, a cyclohexyl group, a 1,3-cyclohexa dienyl group, 2-cyclopentene 1-yl groups, 2,4-cyclopentadien-1-ylidene group, etc. As an aromatic ring group which is not replaced [substitution or], a phenyl group, a BIFFENIRENIRU group, A TORIFENIRENIRU group, a TETORAFENIRENIRU group, 3-nitrophenyl group, 4-methylthio phenyl group, a 3,5-dicyano phenyl group, o-, m-, and p-tolyl group, A xylyl group, o-, m- and p-KUMENIRU group, a mesityl group, a pentenyl group, An indenyl group, a naphthyl group, an azulenyl group, the Cheb Tare Nils group, an ASENAFUCHIRENIRU group, A phenalenyl group, a fluorenyl group, an anthryl group, an anthraquinonyl group, 3-methyl anthryl group, a phenan tolyl group, a TORIFENIRENIRU group, A pyrenyl group, a KURISENIRU group, a 2-ethyl-1-KURISENIRU group, a PISENIRU group, A peri RENIRU group, 6-chloro peri RENIRU group, a penta phenyl group, a penta SENIRU group, There are a TETORAFENIRENIRU group, a hexa phenyl group, a hexa SENIRU group, a kana SENIRU group, the Kolone Nils group, a TORINAFUCHIRENIRU group, a hepta phenyl group, a hepta SENIRU group, a pyran TORENIRU group, an OBARENIRU group, etc.

[0015]There are the following substituents as R^3 of the compound shown by the general formula [1] of this invention - an example of representation of R^{12} . As a hydrogen atom and a halogen atom, as an alkoxy group which is not replaced [fluoride, chlorine, bromine, iodine substitution, or], There are a methoxy group, an ethoxy basis, a propoxy group, n-butoxy group, a sec-butoxy group, a tert-butoxy group, a pentyloxy group, a hexyloxy group, a stearyloxy group, a trifluoro methoxy group, etc. As a thioalkoxy group which is not replaced [substitution or], there are a methylthio group, an ethyl thio group, a propyl thio group, a butyl thio group, a sec-butyl thio group, a tert-butyl thio group, a pentyl thio group, a hexyl thio group, a heptyl thio group, an octylthio group, etc.

[0016]As a JI substituted amino group, mono- **** A methylamino group, a dimethylamino group, An ethylamino group, a diethylamino group, a dipropylamino group, a dibutylamino group, There are a diphenylamino group, a bis(aceto oxymethyl)amino group, a bis(aceto oxyethyl)amino group, a bis(aceto oxypropyl)amino group, a bis(aceto oxybutyl)amino group, a dibenzylamino group, etc. As an aryloxy group which is not replaced [substitution or], there are a phenoxy group, a p-tert-butyl FENIKISHI group, a 3-fluoro FENIKISHI group, etc. As an arylthio group which is not replaced [substitution or], there are a phenylthio group, a 3-fluoro phenylthio group, etc.

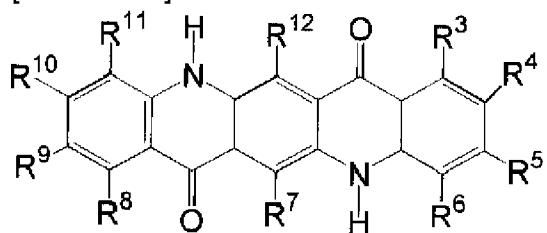
[0017]As a heterocycle group which is not replaced [substitution or], a thionyl group, a furil group, a pyrrolyl group, An imidazolyl group, a pyrazolyl group, a pyridyl group, a pyrazinyl

group, a pyrimidinyl group, A pyridazinyl group, an indolyl group, a quinolyl group, an isoquinolyl group, a phthalazinyl group, A quinoxalinyl group, a chinae-cortex ZORINIRU group, a carbazolyl group, an acridinyl group, Although there are a FENAJINIRU group, a furfuryl group, an isothiazolyl group, an isoxazolyl group, a furazanyl group, a phenoxazinyl group, a benzothiazolyl group, a benzoxazolyl group, a benzimidazolyl group, a 2-methyl pyridyl group, a 3-cyano pyridyl group, etc., It is not concretely limited to the above-mentioned substituent.

[0018]Although the synthesizing method of the quinacridone series compound of the general formula [1] of this invention has a method (the west, a color and medicine, 13 volumes, 81-page 1968) of making alkyl halide or aryl halide replace by unplaced Quinacridone shown by a general formula [4], it is not limited to this.

General formula [4]

[Formula 7]



R³ - R¹² express the same meaning as the above among [type.]

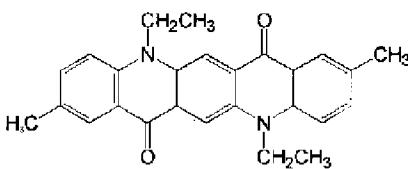
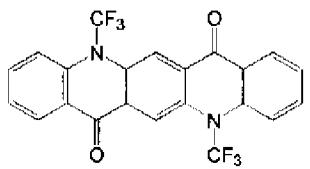
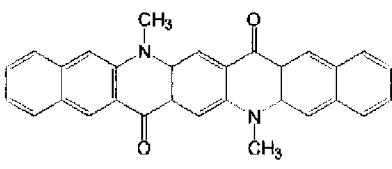
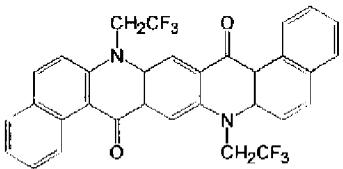
[0019]Although an example of representation of a quinacridone series compound of this invention is concretely illustrated to Table 1, it is not limited to these.

[0020]

[Table 1]

化合物	化学構造
(1)	
(2)	
(3)	
(4)	

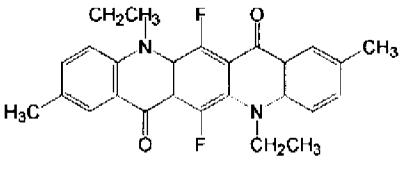
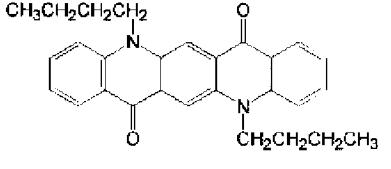
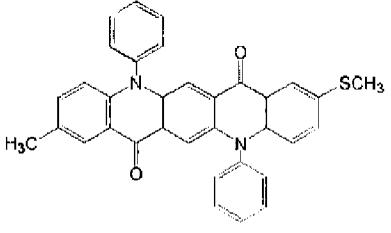
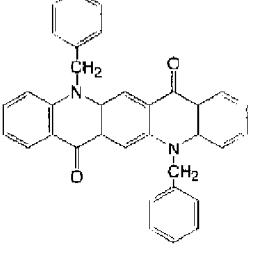
[0021]

化合物	化学構造
(5)	
(6)	
(7)	
(8)	

[0022]

化合物	化学構造
(9)	
(10)	
(11)	
(12)	

[0023]

化合物	化学構造
(13)	
(14)	
(15)	
(16)	

[0024]An example of B¹ of a compound shown by a general formula [2] in this invention - B⁴ is an aryl group with 6-20 carbon atoms which are not replaced [substitution or]. It is an aryl group which may contain nitrogen atoms, such as a phenyl group, a biphenyl group, a terphenyl group, a naphthyl group, an anthryl group, a phenan tolyl group, a fluorenyl group, and a pyrenyl group, and, specifically, each aryl group may have a substituent. G is an allylene group of bivalence and A a phenylene group, a biphenylene group, It is an allylene group of bivalence which may contain nitrogen atoms, such as a terphenylene group, a naphthylene group, anthrylene group, a phenan tolylene group, a full ORENIREN group, and a pyrenylene group, and each aryl group may have a substituent.

[0025]Although the example of the compound of the general formula [2] of this invention which

is a luminescent material effective for below, and other materials is concretely illustrated to Table 2, this invention is not limited to this example of representation.

[0026]

[Table 2]

化合物	化 学 構 造
A - 1	
A - 2	
A - 3	
A - 4	

[0027]

化合物	化 学 構 造
A - 5	
A - 6	
A - 7	
A - 8	

[0028]

化合物	化 学 構 造
A - 9	
A - 10	
A - 11	
A - 12	

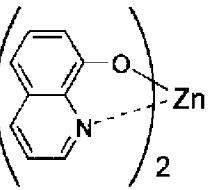
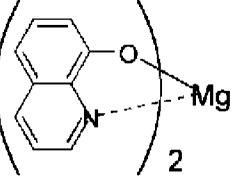
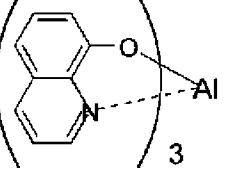
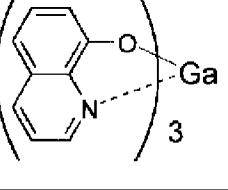
[0029]

[0030] Q^1 of the compound shown by the general formula [3] in this invention and Q^2 , 8-hydroxyquinoline, 8-hydroxyquinaldine, 8-hydroxy-2-phenylquinoline, Hydroxyquinoline derivatives, such as 8-hydroxy-5-methylquinoline and 8-hydroxy-3,5,7-trifluoroquinoline, and L, The cycloalkyl group which is not replaced [the alkyl group which is not replaced / a halogen atom, substitution, or /, substitution or], the aryl group which may also contain the nitrogen atom which is not replaced [substitution or], and -OR (R -- a hydrogen atom.) The cycloalkyl group which is not replaced [the alkyl group which is not replaced / substitution or /, substitution or], It is an aryl group which may also contain the nitrogen atom which is not replaced [substitution or]. -O-Ga-Q³ (Q⁴) (Q³ and Q⁴ express the same meaning as Q¹ and Q².) is shown. Here, a halogen atom, an alkyl group, a cycloalkyl group, the aryl group that may also contain a nitrogen atom and the alkyl group of R of -OR group, a cycloalkyl group, and the aryl group that may also contain a nitrogen atom express the same basis as R¹ described by the aforementioned general formula [1] - R¹².

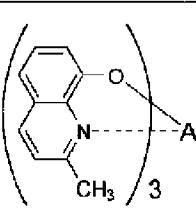
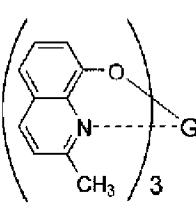
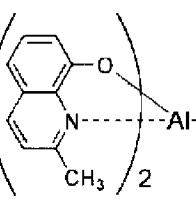
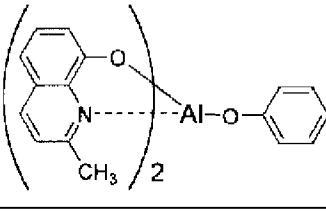
[0031]Although the example of representation of the compound of a general formula [3] and the example of representation of electron injection material which are used for the organic EL device of this invention below are concretely illustrated to Table 3, this invention is not limited to this example of representation.

[0032]

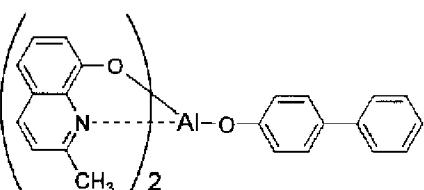
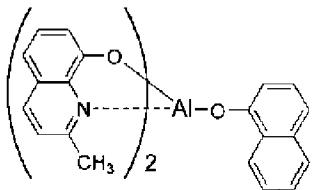
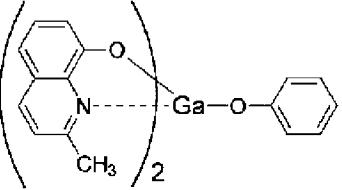
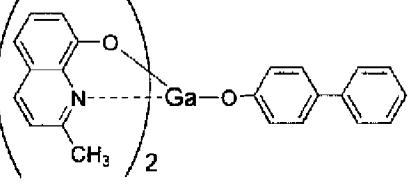
[Table 3]

化合物	化 学 構 造
B - 1	
B - 2	
B - 3	
B - 4	

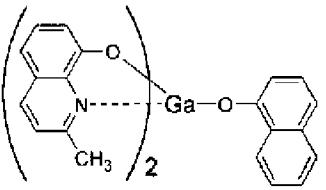
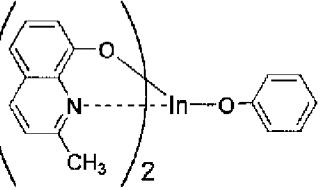
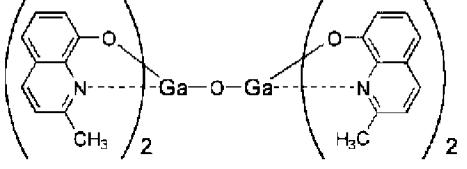
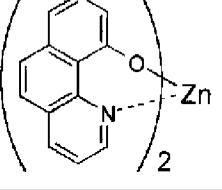
[0033]

化合物	化 学 構 造
B - 5	
B - 6	
B - 7	
B - 8	

[0034]

化合物	化 学 構 造
B - 9	
B - 1 0	
B - 1 1	
B - 1 2	

[0035]

化合物	化 学 構 造
B - 1 3	
B - 1 4	
B - 1 5	
B - 1 6	

[0036]

化合物	化 学 構 造
B - 1 7	
B - 1 8	
B - 1 9	
B - 2 0	

[0037]The compound shown by the general formula [1] of this invention is a compound which has strong fluorescence in a solid state, and is excellent also in electroluminescence nature. Since it has electron injection nature and electron transport property outstanding from hole-injection nature and electron hole transportability, a metal electrode, or an organic thin film layer outstanding from the metal electrode or the organic thin film layer with it collectively, It does not interfere, even if it can be used effectively and uses the electron hole transportability material, electron-transport-property material, or doping materials of further others as a luminescent material.

[0038]an organic EL device -- between the anode and the negative pole -- much more -- or it is an element in which the multilayer organic thin film was formed. In the case of the mold, the luminous layer is further provided between the anode and the negative pole. A luminous layer contains a luminescent material, and in order even for a luminescent material to make the electron poured in from the electron hole which was poured in from the anode in addition to it, or the negative pole convey, it may contain a hole transporting material or an electron transport material. A multilayer type has the organic EL device laminated by the multilayered constitution of (the anode / hole injection layer / luminous layer / negative pole), (the anode / luminous

layer / electronic injection layer / negative pole), and (the anode / hole injection layer / luminous layer / electronic injection layer / negative pole). Since the quinacridone compound of a general formula [1] is an electron-transport-property compound, it can be used for an electronic injection layer, an electron transport layer, an electron-transport-property luminous layer, etc. using the electron transport property. Since this compound had strong fluorescence, it was also possible to have used it as a luminescent material, but the optimal selection of high luminous efficiency and a luminous wavelength was attained by doping at a rate that it is the optimal in a luminous layer as doping materials.

[0039] Metal complexes, such as a tris (8-hydroxyquinoline) aluminium complex, are used as a luminescent material (host substance) of a luminous layer, the compound of a general formula [1] is used as doping materials (guest substance), light emitting luminance is high and the organic EL device excellent in the stability at the time of repeated use can be obtained. As for the compound of a general formula [1], in a luminous layer, it is desirable to contain to a host substance in 0.001 % of the weight - 50% of the weight of the range, and also 0.01 % of the weight - 5% of the weight of its range is effective for it. In the quinacridone compound of the general formula [1] of this invention, it is usable also as an electron-transport-property material. For example, it can also be used as a material which constitutes the use or the electronic injection layer as an electron transport material out of a luminous layer. The quinacridone compound of the general formula [1] of this invention, Since the nitrogen atom and the substituent had joined together instead of N-H combination of a quinacridone molecule as the general formula [1] prescribed into chemical structure, in the wet forming-membranes methods, such as a spin coat method, it became possible for the solubility to a solvent to make it exist uniformly in each class highly. Therefore, also when doping to a luminescent material in a luminous layer, it is very effective, in order that the career poured in from each electrode may be enabled to recombine uniformly within a luminous layer and it may produce a high-intensity and long lasting organic EL device.

[0040] In addition to a luminescent material and a luminescence auxiliary material, a hole transporting material and an electron transport material can also be used for a luminous layer if necessary.

[0041] The organic EL device can prevent the fall of the luminosity by quenching, or a life by using multilayer structure. It can also be used if necessary, combining a luminescent material, doping materials, and the hole transporting material and electron transport material that perform carrier transport two or more kinds. A hole injection layer, a luminous layer, and an electronic injection layer may be formed of the lamination more than a bilayer, respectively, an electron hole or an electron is efficiently poured in from an electrode, and the element structure conveyed in a layer is chosen.

[0042] The conductive material used for the anode of an organic EL device, A thing with a

bigger work function than 4 eV is preferred, and Carbon, aluminum, Organic conductive resin, such as metal oxide, such as tin oxide, indium oxide, etc. which are called those alloys, an ITO board, and a NESA board, such as vanadium, iron, cobalt, nickel, tungsten, silver, gold, platinum, and palladium, and also a polythiophene, and polypyrrole, is used. Although a thing with a work function smaller than 4 eV is preferred for the conductive material used for the negative pole and those alloys, such as magnesium, calcium, tin, lead, titanium, yttrium, lithium, a ruthenium, and manganese, are used, it is not limited to these. As long as the anode and the negative pole have necessity, they may be formed of the lamination more than a bilayer.

[0043]In order to make light emit efficiently in an organic EL device, in the luminous wavelength field of an element, the transparent enough thing of at least one side is desirable. The transparent thing of a substrate is desirable. The above-mentioned conductive material is used for a transparent electrode, and it sets it up secure predetermined translucency by methods, such as vacuum evaporation and sputtering. As for the electrode of a light-emitting surface, it is desirable to make light transmittance not less than 10%. If a substrate has mechanical and thermal intensity, it is not limited if it is transparent, but it is illustrated, transparent resin, such as a glass substrate, a polyethylene board, a polyether sulphone board, and a polypropylene board, will be raised.

[0044]The formation of each class of the organic EL device concerning this invention can apply which method of the wet forming-membranes methods, such as the dry type forming-membranes methods, such as vacuum deposition and sputtering, spin coating, dipping. Although thickness in particular is not limited, it needs to set each class as suitable thickness. If thickness is too thick, in order to obtain fixed optical power, big impressed electromotive force will be needed and efficiency will worsen. If thickness is too thin, even if a pinhole etc. will occur and it will impress an electric field, sufficient light emitting luminance is not obtained. Although the range of 10 micrometers is preferred for the usual thickness from 5 nm, the range of 0.2 micrometer is still more preferred from 10 nm.

[0045]The solvent may be any, although the material which forms each class is dissolved or distributed to suitable solvents, such as chloroform, a tetrahydrofuran, and dioxane, in the case of the wet forming-membranes method and a thin film is formed. Also in which thin film, suitable resin and additive agent may be used on a membrane formation disposition for membranous pinhole prevention etc. As such resin, polystyrene, polycarbonate, polyarylate, Polyester, polyamide, polyurethane, polysulfone, polymethylmethacrylate, Conductive resin, such as photo electroconductive polymer, such as insulating resin, such as polymethyl acrylate and cellulose, poly-N-vinylcarbazole, and polysilane, a polythiophene, and polypyrrole, can be mentioned. An antioxidant, an ultraviolet ray absorbent, a plasticizer, etc. can be mentioned as an additive agent.

[0046]As the luminescent material or doping materials which can be used for the organic EL device of this invention, Anthracene, naphthalene, phenanthrene, pyrene, tetracene, Coronene, a chrysene, fluorescein, perylene, phtalo perylene, Non [naphthalo perylene and peri non, / phtalo peri non, / naphthalo peri], Diphenylbutadiene, tetraphenylbutadiene, a coumarin, oxadiazole, Aldazine, screw benzo KISAZORIN, screw styryl, pyrazine, a cyclopentadiene, A quinoline metal complex, an aminoquinoline metal complex, imine, diphenylethylene, Although there are those derivatives, such as vinylanthracene, diaminocarbazole, Piran, thiopyran, poly methine, merocyanine, an imidazole chelation oxy NOIDO compound, Quinacridone, and rubrene, it is not limited to these. As a still more effective luminescent material, it is a compound of the general formula [2] of this invention.

[0047]The compound which has the capability to convey an electron hole, as a hole transporting material, has the hole-injection effect outstanding to the luminous layer or the luminescent material, and prevented movement to the electronic injection layer or electron transport material of an exciton generated by the luminous layer, and was excellent in thin-film-forming ability is mentioned. Specifically A phthalocyanine system compound, a naphthalocyanine system compound, A porphyrin system compound, oxadiazole, triazole, imidazole, Imidazolone, imidazolethione, pyrazoline, a pyrazolone, tetrahydro imidazole, Oxazol, oxadiazole, hydrazone, acyl hydrazone, A poly aryl alkane, a stilbene, butadiene, a benzidine type triphenylamine, a styryl amine type triphenylamine, a diamine type triphenylamine, etc., Although there are polymer materials, such as those derivatives and a polyvinyl carbazole, polysilane, and a conductive polymer, etc., it is not limited to these.

[0048]The compound which has the capability to convey an electron, as an electron transport material, has the electron injection effect outstanding to the luminous layer or the luminescent material, and prevented movement to the hole injection layer or hole transporting material of an exciton generated by the luminous layer, and was excellent in thin-film-forming ability is mentioned. For example, fluorenone, anthra quinodimethane, diphenoquinone, thiopyrandoxide, Oxadiazole, thiadiazole, tetrazole, perylene tetracarboxylic acid, The others and the metal complex compound which are FUREORENIRIDEN methane, anthra quinodimethane, Antron, etc. can also use them as electron transport materials, and as a desirable example, Tris(8-hydroxyquinoline) aluminum, bis(8-hydroxyquinoline)zinc, Bis(8-hydroxyquinoline)magnesium, bis(benzo (f)-8-hydroxyquinoline)copper, Bis(2-methyl-8-hydroxyquinoline)aluminum oxide, Tris(8-hydroxyquinoline) gallium, tris(8-hydroxyquinoline) indium, Tris(5-methyl-8-hydroxyquinoline) aluminum, 8-hydroxy kino RINRICHIMU, Tris(5-chloro-8-hydroxyquinoline) aluminum, bis(10-hydroxybenzo "H] quinolinate)beryllium, Bis(10-hydroxybenzo "H] quinolinate)zinc, bis(2-methyl-8-quinolinate)chlorogallium, bis(2-methyl-8-quinolinate)(O-cresolate) gallium, Although bis(2-methyl-8-quinolinate)(1-naphtho RATO) aluminum, bis(2-methyl-8-quinolinate)(2-naphtho RATO) gallium, etc. are mentioned, it is not

limited to these. As a still more effective luminescent material, it is a compound of the general formula [3] of this invention. An electronic acceptance substance can be added to a hole transporting material, an electron-donative substance can be added to an electron transport material, and sensitization can be carried out.

[0049]Even if the thing within a luminous layer to use is desirable and a luminescent material, doping materials, a hole transporting material, and an electron transport material have them as doping materials as a luminescent material, a kind may contain the compound of the general formula [1] of this invention in the same layer. [few] Since the compound of a general formula [1] has electron transportation capability, it can also be used for an electronic injection layer.

[0050]It is also possible to provide a protective layer on the surface of an element, or to enclose a silicone oil etc. and to protect the whole element for the improvement of stability to the temperature of the organic EL device obtained by this invention, humidity, atmosphere, etc.

[0051]As mentioned above, in this invention, since the compound of the general formula [1] was used for the organic EL device, luminous efficiency was able to be made high. This element was dramatically stable to heat or current, and since usable light emitting luminance was further obtained practical by the low voltage, degradation by the temporality which was a big problem to the former, and emission time were able to be raised substantially, and it was able to use for the improvement in a life of an organic EL device. .The organic EL device of this invention can consider application as flat-panel displays, such as a flat TV, and a plane emitter to light sources, such as a copying machine and a printer, light sources, such as a liquid crystal display and instruments, the plotting board, a beacon light, etc., and the industrial value is dramatically large.

[0052]

[Example]Hereafter, this invention is explained still in detail based on an example.

2.4 copies of synthesizing method compounds (2) of a compound (1), 50 copies of benzene, 150 copies of 50% sodium hydroxide solution, 2.5 copies of orange crystals were obtained by carrying out heating churning for 12 hours, and a ** exception's swabbing the precipitated crystal in methanol and drying 2.1 copies of benzyl triethyl ammonium chloride, and 57.2 copies of ethyl iodide at 80 **. It checked that it was a compound (1) with ultimate analysis, molecular weight analysis, and an NMR spectrum. The infrared absorption spectrum (KBr tablet method) of this compound is shown in drawing 1, and a fluorescence spectrum is shown in drawing 2.

[0053]On the glass plate with an ITO electrode washed example 1-16, vacuum deposition of N,N' -(4 **MECHIRU phenyl)-N' - (4-n-butylphenyl) **FENAN Trenn 9 and 10 **JIAMIN was carried out, and the hole injection layer of 50 nm of thickness was obtained.

Subsequently, vacuum vapor codeposition of the compound indicated to a tris (8-quinolinate)

aluminium complex and Table 4 was carried out by the weight ratio of 50:1, the luminous layer of 50 nm of thickness was created, the electrode of the thickness of 150 nm of thickness was formed on it with the alloy which mixed silver with magnesium by 10:1, and the organic EL device was obtained. A hole injection layer, a luminous layer, and the negative pole were vapor-deposited under the conditions of a substrate temperature room temperature in the vacuum of 10^{-6} Torr. The light emitting luminance which shows this element in Table 4 with the direct current voltage 5V was obtained.

[0054]

[Table 4]

実施例	化合物	発光輝度 (cd/m ²)	発光効率 (lm/W)
1	(1)	1400	4.0
2	(2)	1500	4.4
3	(3)	1450	4.2
4	(4)	1380	3.9
5	(5)	1450	4.2
6	(6)	1350	3.8
7	(7)	1470	4.3
8	(8)	1310	3.6
9	(9)	1400	3.9
10	(10)	1550	4.4
11	(11)	1290	3.7
12	(12)	1500	4.2
13	(13)	1370	3.6
14	(14)	1480	4.2
15	(15)	1450	4.1
16	(16)	1360	3.9

[0055] Except changing the comparative example 1 - 3 quinacridone compounds into the quinacridone compound shown in Table 3 from the compound of an example, the organic EL device was produced by the same method as Examples 1-16, and light emitting luminance was measured. The light emitting luminance which shows this element in Table 5 with the direct current voltage 5V was obtained.

[0056]

[Table 5]

比較例	化合物	発光輝度 (cd/m ²)	発光効率 (lm/W)
1	キナクリドン化合物なし	390	0.92
2	無置換キナクリドン	530	1.31
3	ジメチルキナクリドン	480	1.28

[0057] On the glass plate with an ITO electrode washed example 17, vacuum deposition of N,N'-(4 **MECHIRU phenyl)-N and N' - (4-n-butylphenyl) **FENAN Trenn 9 and 10 **JIAMIN was carried out, and the hole injection layer of 50 nm of thickness was obtained. Subsequently, chloroform was made to carry out dissolution distribution of the quinacridone

compound (14), and the luminous layer of 50 nm of thickness was obtained by the spin coating method. The electrode of 150 nm of thickness was formed with the alloy which moreover mixed silver with magnesium by 10:1, and the organic EL device was obtained. A hole injection layer and the negative pole were vapor-deposited under the conditions of a substrate temperature room temperature in the vacuum of 10^{-6} Torr. As for this element, the light emitting luminance of 20 (cd/m^2) was obtained with the direct current voltage 5V.

[0058]On the glass plate with an ITO electrode washed example 18, a tris (8-quinolinate) aluminium complex, Quinacridone compound (1) N,N' **JIFENIRU** N,N' -(3 **MECHIRU phenyl)-1, 1 **BIFENIRU** 4 and 4' **JIAMIN, Chloroform was made to carry out dissolution distribution of the poly-N-vinylcarbazole by the ratio of 3:0.05:2:5, and the luminous layer of 100 nm of thickness was obtained by the spin coating method. The electrode of 150 nm of thickness was formed with the alloy which moreover mixed silver with magnesium by 10:1, and the organic EL device was obtained. A luminous layer and the negative pole were vapor-deposited under the conditions of a substrate temperature room temperature in the vacuum of 10^{-6} Torr. As for this element, the light emitting luminance of 540 (cd/m^2) was obtained with the direct current voltage 5V.

[0059]Except removing comparative example 4 quinacridone compound, the organic EL device was produced by the same method as Example 18, and light emitting luminance was measured. As for this element, the light emitting luminance of 180 (cd/m^2) was obtained with the direct current voltage 5V.

[0060]On the glass plate with an ITO electrode washed example 19, vacuum deposition of N,N' -(4 **MECHIRU phenyl)-N and N' - (4-n-butylphenyl) **FENAN Trenn 9 and 10 **JIAMIN was carried out, and the hole injection layer of 50 nm of thickness was obtained. Subsequently, vacuum deposition of the compound (A-4) of Table 2 was carried out, and the luminescent material of 40 nm of film pressure was obtained. Subsequently, the tris (8-quinolinate) aluminium complex and the quinacridone compound (3) were vapor-deposited by the weight ratio of 50:1, the electronic injection layer of 30 nm of thickness was created, the electrode of 100 nm of thickness was formed on it with the alloy which mixed silver with magnesium by 10:1, and the organic EL device was obtained. The hole injection layer and the luminous layer were vapor-deposited under the conditions of a substrate temperature room temperature in the vacuum of 10^{-6} Torr. As for this element, the light emitting luminance of 210 (cd/m^2) was obtained with the direct current voltage 5V.

[0061]As example 20 luminescent material, it replaced with the tris (8-quinolinate) aluminium complex, and the organic EL device was created by the same method as Example 19 except using a bis(2-methyl-8-quinolinate)(1-naphtho RATO) gallium complex. As for this element, the

light emitting luminance of 250 (cd/m²) was obtained with the direct current voltage 5V.

[0062]On the glass plate with an ITO electrode washed example 21, vacuum deposition of N,N' -(4 **MECHIRU phenyl)-N and N' - (4-n-buthylphenyl) **FENAN Trenn 9 and 10 **JIAMIN was carried out, and the hole injection layer of 30 nm of thickness was obtained.

Subsequently, a tris (8-hydroxyquinoline) aluminium complex and a quinacridone compound (10) are vapor-deposited by the weight ratio of 50:1, The luminous layer of 30 nm of ***** was created, and the electronic injection layer of 20 nm of thickness of [2-(4-tert-buthylphenyl)-5-(biphenyl)-1, 3, and 4-oxadiazole] was further obtained with the vacuum deposition method. The electrode of 150 nm of thickness was formed with the alloy which moreover mixed silver with magnesium by 10:1, and the organic EL device was obtained. A hole injection layer, a luminous layer, an electronic injection layer, and the negative pole were vapor-deposited under the conditions of a substrate temperature room temperature in the vacuum of 10⁻⁶Torr. As for this element, about 1450 (cd/m²) light emitting luminance was obtained with the direct current voltage 5V.

[0063]On the glass plate with an ITO electrode washed example 22, vacuum deposition of N,N' -(4 **MECHIRU phenyl)-N and N' - (4-n-buthylphenyl) **FENAN Trenn 9 and 10 **JIAMIN was carried out, and the hole injection layer of 50 nm of thickness was obtained.

Subsequently, as a luminous layer, the compound (A-11) and quinacridone compound (3) of Table 2 were vapor-deposited by the weight ratio of 50:1, the luminous layer of 30 nm of thickness was created, the electrode of 100 nm of thickness was formed on it with the alloy which mixed silver with magnesium by 10:1, and the organic EL device was obtained. The hole injection layer and the luminous layer were vapor-deposited under the conditions of a substrate temperature room temperature in the vacuum of 10⁻⁶Torr. As for this element, the light emitting luminance of 110 (cd/m²) was obtained with the direct current voltage 5V.

[0064]On the glass plate with an ITO electrode washed example 23, vacuum deposition of N,N' -(4 **MECHIRU phenyl)-N and N' - (4-n-buthylphenyl) **FENAN Trenn 9 and 10 **JIAMIN was carried out, and the hole injection layer of 30 nm of thickness was obtained.

Subsequently, vacuum deposition of the compound (A-8) of Table 2 was carried out, the luminous layer of 30 nm of thickness was created, on it, the compound (B-12) and quinacridone compound (10) of Table 3 were vapor-deposited by the weight ratio of 50:1, and the electronic injection layer of 30 nm of thickness was obtained. The electrode of 150 nm of thickness was formed with the alloy which moreover mixed silver with magnesium by 10:1, and the organic EL device was obtained. A hole injection layer, a luminous layer, an electronic injection layer, and the negative pole were vapor-deposited under the conditions of a substrate temperature room temperature in the vacuum of 10⁻⁶Torr. As for this element, about 1450

(cd/m²) light emitting luminance was obtained with the direct current voltage 5V.

[0065]The compound (B-3) and quinacridone compound (16) of Table 3 were vapor-deposited by the weight ratio of 50:1 to example 24 electronic injection layer, except creating the electronic injection layer of 30 nm of thickness, the organic EL device was produced by the same method as Example 20, and light emitting luminance was measured. As for this element, the light emitting luminance of 1510 (cd/m²) was obtained with the direct current voltage 5V.

[0066]About all the organic EL devices shown by this example, when carrying out continuation luminescence by 3 (mA/cm²), were able to observe stable luminescence for 10000 hours or more, but. The organic EL device of the comparative example produced on the conditions became below half of early light emitting luminance by the emission time of 500 or less hours, and the effect of the organic EL device of this invention was clear. The organic EL device of this invention attains improvement in luminous efficiency and light emitting luminance, and reinforcement, and does not limit element manufacturing methods, such as a luminescent material, doping materials, a hole transporting material, an electron transport material, a sensitizer, resin, an electrode material, etc. which are used collectively.

[0067]

[Effect of the Invention] By this invention, compared with the former, it is high luminous efficiency and high-intensity, and the long lasting organic EL device was able to be obtained. By using the compound shown by this invention for an organic EL device, a wet type and the dry type forming-membranes method are easy for this, it existed uniformly to the luminescent material, and could also solve decline in the luminous efficiency by concentration quenching, and it became possible to produce easily an organic EL device with high luminous efficiency.

[Translation done.]